Remarks/Arguments

Claims 1-47 are pending in this application. Claims 1, 2, 8-13, 16, 24-27, 29, 32-34, 37, 39 and 40 were rejected under U.S.C. § 102(e) as allegedly unpatentable over Patent Publication U.S. 2002/0084183 A1 ("Hanson"). Claims 3, 4, 18-21 and 30 were rejected under U.S.C. § 103(a) as allegedly unpatentable over Hanson in view of U.S. Patent No. 6,540,899 ("Keigler"). Claims 14, 15, 17, 22, 23, 35, 36 and 38 were rejected under U.S.C. § 103(a) as allegedly unpatentable over Hanson in view of U.S. Patent No. 5,000,827 ("Schuster"). These rejections are traversed for reasons including those set forth below. The Office Action noted that claim 28 was objected to as being dependent from a rejected base claim, but would be allowable if rewritten in independent form.

Claim 1 was amended to correct a typographical error. Claims 17 and 38 were amended to more clearly distinguish the art relied upon in the Office Action. New claims 41-47 are presented in this amendment. It is respectfully submitted that claims 1-47 are allowable for reasons including those stated below.

Claims 1-23

In Amendment A, the "flow path" element of claim 1 was amended to recite:

> a flow path defining a passage for plating fluid to flow from inside the apparatus to outside the apparatus, said flow path residing in a region between the field shaping region and the cup and having an inlet on the inside of the apparatus and proximate the cup's lip and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet when the apparatus oriented for use with the cup above the field shaping element . . . .

This amendment is supported, for example, by Fig. 1E of the present application. Flow path 147 is defined by field shaping element 127 and cup 125. The inlet of this defined region is proximate lip 131 of cup 125. In the present amendment, claim 1 was amended only to correct a typographical error: "field shaping region" was changed to "field shaping ~~region~~ element."

Claim 1 also recites:

> a field shaping element shaped and sized to affect an electric field shape impinging on the work piece during plating, *the field shaping element designed for connection with the cup;*

(Emphasis added.)

One such connection is screw 133: "A screw (e.g., screw 133 shown in Fig. 1C) fastens field shaping element 127 to cup125 as indicated by a threaded hole 141." (Specification at p. 14, lines 33-34, referring also to Fig. 1D.)

It is respectfully submitted that Hanson does not teach a field shaping element designed for connection with a cup. Hanson describes field shaping elements 195 and 200 as follows:

> FIGS. 5 and 6 are isometric views of two embodiments of field shaping elements 195, 200 that may be used in the reactor 10. The field shaping elements 195, 200 generally each comprise a single plate of material having one or more openings through which plating fluid and/or current is enabled to flow. Depending on the opening pattern a more controlled distribution of plating fluid and current across the surface of the workpiece 45 can be achieved.

(Id. at paragraph [0058].)

The Office Action has identified contact assembly 60 of Hanson with the cup recited in claim 1. This assertion is respectfully traversed, but even if it were true, the field shaping elements of Hanson do not connect with contact assembly 60. Instead, the field shaping elements of Hanson fit into horizontal grooves of the reactor wall. For example, as shown in Fig. 7 of Hanson, field shaping element 200 fits into a horizontal groove 190 of the reactor wall 75.

Moreover, the recitation in claim 1 that the field shaping element is designed for connection with the cup clarifies the recitation of the flow path as "residing in a region

between the field shaping element and the cup and having an inlet on the inside of the apparatus and proximate the cup's lip and an outlet on the outside of the apparatus." Because the field shaping element recited in claim 1 is designed for connection with the cup, the recited flow path is between (i.e., bounded by) the cup and the field shaping element, thereby "one or more flow paths are formed each having an inlet 144 and an outlet 146." (Specification at p. 14, line 34 to p. 15, line 1, referring to Fig. 1D.)

As understood, Hanson does not teach a flow path comparable to that disclosed and claimed in the present invention. The description and illustrations of Hanson do not provide a clear indication of the flow path in the vicinity of the workpiece. The Office Action identifies the region in Fig. 7 between field shaping element 200 and contact assembly 60 as both the "inlet" and the "flow path" recited in claim 1. (Office Action at page 5, e.g., in rows 1 and 4 of the table.) This interpretation ignores the distinction between the inlet of the flow path and the flow path itself, as recited in claim 1.

Moreover, the Office Action does not identify the outlet or describe its relationship to the flow path and inlet. This relationship is clearly recited in claim 1: "the outlet is at a higher elevation than the inlet when the apparatus oriented for use with the cup above the field shaping element." Hanson, as understood, fails to teach, suggest or indicate this relationship. The previously presented arguments regarding claims 1-23 are hereby incorporated by reference.

For at least the foregoing reasons, it is respectfully submitted that claim 1 is patentably distinct from the teachings of Hanson. Claims 2-23 are therefore patentable as being dependent from patentable claim 1.

Claims 24-40

Independent method claim 24 recites, in pertinent part:

> while plating, directing a plating fluid through a flow path defining a passage for the plating fluid to flow from inside the apparatus to outside the apparatus, said flow path defined by the cup and the field shaping element, having an inlet on the inside of the apparatus and an outlet on the outside of

the apparatus and positioned such that the outlet is at a higher elevation than the inlet, whereby gas present in a portion of the plating fluid in the flow path travels toward the outlet due to its buoyancy.

As understood, Hanson does not teach the step of directing plating fluid through a flow path as recited in claim 24. The description and illustrations of Hanson do not provide a clear indication of the flow path in the vicinity of the workpiece. The "flow path" referenced in the Office Action is merely a general region of Fig. 7. This area is not "defined by the cup and the field shaping element." Moreover, Hanson does not teach, suggest or indicate a flow path "having an inlet on the inside of the apparatus and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet, whereby gas present in a portion of the plating fluid in the flow path travels toward the outlet due to its buoyancy."

For at least the foregoing reasons, it is respectfully submitted that claim 24 is patentably distinct from the teachings of Hanson. Claims 22-40 are therefore patentable as being dependent from patentable claim 1.

New Claim 41

New claim 41 recites, *inter alia,* a cup having a "first surface being curved and substantially non-parallel to the first plane [of the workpiece] and a "field shaping element having a second surface substantially in conformity with the first surface." Support for this claim may be found, for example, in Figs. 1D and 1E and the corresponding parts of the specification.

According to Fig. 7 of Hanson, field shaping elements 195, 200 are flat and disposed parallel to, and upstream from, the plane of workpiece 45. Hanson, as understood, fails to teach, suggest or indicate a curved field-shaping element that is not parallel to the plane of the workpiece. Therefore, it is respectfully submitted that claim 41 is patentable over Hanson.

New Claim 42

New claim 42 recites, *inter alia:*

> . . . the field shaping element defining a snorkel-shaped flow path between the field-shaping element and the cup, forming a passage for plating fluid to flow from inside the apparatus to outside the apparatus, said snorkel-shaped flow path having an inlet on the inside of the apparatus proximate the cup's lip and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet when the apparatus oriented for use with the cup above the field shaping element . . . .

Support for claim 42 may be found, for example, in the following part of the specification:

> This "snorkel" shape helps to reduce multiple wetting fronts during wafer immersion, as will be explained in more detail below. This design also facilitates bubble removal by taking advantage of the bubbles' buoyancy, which generally removes the bubbles from the system via outlet 146.

(Id. at p. 15, lines 2-5 [referring to Fig. 1D].)

As understood, Hanson does not teach a snorkel-shaped flow path with the geometry recited in claim 42. The description and illustrations of Hanson do not provide a clear indication of the flow path in the vicinity of the workpiece. Therefore, it is respectfully submitted that claim 42 is patentable over Hanson.

New Claims 43-47

New independent apparatus claim 43 recites:

> a cup having a circumferential side wall defining an interior region and a lip within the interior region arranged such that lip can support the work piece in a first plane while the work piece remains within the interior region, the cup comprising a plurality of flow holes disposed below the lip, the

plurality of flow holes shaped and sized to affect an electric field shape impinging on the work piece during plating, the plurality of flow holes defining a plurality of flow paths for plating fluid to flow from inside the apparatus to outside the apparatus, each of the flow paths having an inlet on the inside of the apparatus and proximate the cup's lip and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet when the apparatus oriented for use;

Support for this claim (and for claims 44-47) may be found, for example, in Figs. 3A and 3B and the corresponding parts of the specification. The Office Action has admitted that the art relied upon does not teach any sort of flow holes for defining a plurality of flow paths, much less flow holes having the geometry recited in claims 43-47. (May 15, 2003 Office Action at p. 8, ¶ 2, incorporated by reference in the current Office Action.) The assertion that such flow holes are a result of routine optimization (May 15, 2003 Office Action at p. 8, ¶ 4, incorporated by reference in the current Office Action) is respectfully traversed. The new and unexpected results of such flow paths, including those provided by the flow holes recited above, are described in various parts of the specification. (See, e.g., p. 17, line 20 to p. 18, line 4; p. 14, lines 4-6; and p. 14, line 34 to p. 15, line 15.) Therefore, it is respectfully submitted that claims 43-47 are patentable over the art relied upon.

Claims 17, 22, 23, 38, 45 and 47

Claims 17, 22, 23 and 38 were rejected under U.S.C. § 103(a) as allegedly unpatentable over Hanson in view of U.S. Patent No. 5,000,827 ("Schuster"): "Schuster et al. teach the use of a flow path which is at an offset angle from a centerline of the apparatus toward the outside of the apparatus (Fig. 7, solution output arrows)." (May 15, 2003 Office Action at p. 8, ¶ 3, incorporated by reference in the current Office Action.)

The solution output arrows in Fig. 7 of Schuster indicate a general spreading out in a plane perpendicular to the wafer. In contrast, the flow holes described with reference to Figures 3A and 3B of the present invention are shown to be at an angle with reference to a plane within which the wafer is rotating:

> Figure 3A is a top view cross-section showing that flow path holes 303 provide a path at an angle offset from the direction of the radial vector (e.g., line 305). Figure 3B shows the inlet angles for a series of flow paths 303.
>
> As shown, flow holes 303 are provided beneath the lip 307 of a cup. In the depicted embodiment, the holes are angled away from the radial direction toward the direction of rotation. These flow holes more closely match the natural flow pattern of the rotating fluid.

(Specification at p. 17, lines 23-28.)

In order to more clearly indicate the geometry of the claimed flow holes, claim 17 has been amended as follows:

> The apparatus of claim 14, <u>wherein the cup and cone are configured to hold the work piece in a workpiece plane, and</u> wherein the flow path is angled at an offset angle <u>measured in the workpiece</u> plane from a radial vector from a center line inside the apparatus toward the outside of the apparatus.

Corresponding amendments have been made to claim 38 and new claim 45 includes similar geometric recitations.

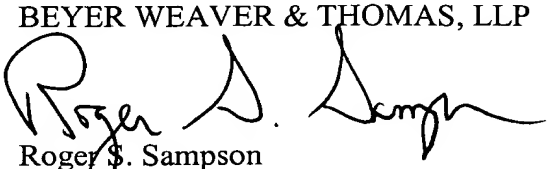
It is respectfully submitted that claims 17, 38 and 45 are allowable over the art relied upon for the additional reasons stated in this section. Therefore, claims 22 and 23 are allowable on these additional grounds as dependent from allowable claim 17. Similarly, claim 47 is allowable on these additional grounds as dependent from allowable claim 45.

Conclusion

In view of the foregoing, it is believed that the rejections of claims 1-40 have been overcome and that new claims 41-47 are allowable over the art relied upon. Therefore, it is respectfully submitted that all claims pending in this application are allowable. Accordingly, an early notification that the application is in condition for allowance is earnestly solicited.

Respectfully submitted,

BEYER WEAVER & THOMAS, LLP



Roger S. Sampson
Reg. No. 44,314

P.O. Box 778
Berkeley, CA 94704-0778
510-843-6200